

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

PEM0036 – CALCULUS

(November Intake)

16 OCTOBER 2017

9.00 a.m. – 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **FOUR (4) pages** including cover page and appendix with **FOUR (4) questions** only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided. All necessary working **MUST** be shown.
4. Only non-programmable calculator is allowed.

QUESTION 1 [25 marks]

(a) For the following functions, determine the respective limit using both simplification method and L'Hopital's Rule:

(i) $\lim_{x \rightarrow -4} \frac{x^2 + 4x}{x^2 + x - 12}$ (4 marks)

(ii) $\lim_{x \rightarrow \infty} \frac{4x^4 + 2x^2}{6x^6 + 13}$ (6 marks)

(b) A piecewise function is defined as below:

$$f(x) = \begin{cases} 9\ln(2x + a) & \text{for } x \leq -1 \\ 9 & \text{for } -1 < x < 2 \\ (x - b)^{1/3} + 9 & \text{for } x \geq 2 \end{cases}$$

Do the following:

(i) Determine values of constant a and b assuming that the $f(x)$ continuous. (6 marks)

(ii) Verify the answers in (a) using continuity check list. (9 marks)

QUESTION 2 [25 marks]

For the following questions, round up any fractions/roots up to 3 decimals throughout the computation.

(a) Verify that $y = x \ln(x)$ has absolute minimum point at $(0.368, -0.368)$. (8 marks)

(b) Use second order differentiation to find local extreme point(s) for $y = x^3 + 4x^2 + \ln 5$. (8 marks)

(c) Show that $(0, 0)$ is an inflection point for $y = 3xe^{x^2}$. (9 marks)

Continued.....

QUESTION 3 [25 marks]

A region is enclosed by functions $y = (x - 4)^2 + 8$ and $y = 24$, do the following:

- (a) Sketch the region. (3 marks)
- (b) Determine the volume of a solid generated by revolving the region about $y = 24$ using volume by disk method. (7 marks)
- (c) Determine the volume of a solid generated by revolving the region about $y = 0$ using volume by washer method. (8 marks)
- (d) Determine the volume of a solid generated by revolving the region about $x = 0$ using volume by shell method. (7 marks)

QUESTION 4 [25 marks]

- (a) Solve the differential equation, $\frac{dy}{dx} = 5 - 7y$ assuming that:

- (i) the given differential equation is separable. (8 marks)
- (ii) the given differential equation is non-separable. (7 marks)

- (b) Verify whether equation $y = \frac{3e^4}{5}e^{-4x} + \frac{2}{5e^6}e^{6x}$ is the solution to differential equation

$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 24y = 0$ by solving the ODE if $y(1) = 1$ and $y'(1) = 0$. (10 marks)

Continued.....

APPENDIX

BASIC DIFFERENTIATION AND INTEGRATION FORMULAS

$$\frac{d}{dx} [\sin x] = \cos x$$

$$\frac{d}{dx} [\cos x] = -\sin x$$

$$\frac{d}{dx} [\tan x] = \sec^2 x$$

$$\frac{d}{dx} [\sec x] = \sec x \tan x$$

$$\frac{d}{dx} [\cot x] = -\csc^2 x$$

$$\frac{d}{dx} [\csc x] = -\csc x \cot x$$

$$\frac{d}{dx} [e^x] = e^x$$

$$\frac{d}{dx} [\ln x] = \frac{1}{x} ; \quad x > 1$$

$$\frac{d}{dx} [\sin^{-1} x] = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx} [\cos^{-1} x] = -\frac{1}{\sqrt{1-x^2}} \text{ for } -1 < x < 1$$

$$\frac{d}{dx} [\tan^{-1} x] = \frac{1}{1+x^2}$$

$$\frac{d}{dx} [\cot^{-1} x] = -\frac{1}{1+x^2} \text{ for } -\infty < x < \infty$$

$$\frac{d}{dx} [\sec^{-1} x] = \frac{1}{|x|\sqrt{x^2-1}}$$

$$\frac{d}{dx} [\csc^{-1} x] = -\frac{1}{|x|\sqrt{x^2-1}} \text{ for } |x| > 1$$

$$\int \tan u \, du = \ln|\sec u| + C$$

$$\int \sec u \, du = \ln|\sec u + \tan u| + C$$

$$\int \cot u \, du = \ln|\sin u| + C$$

$$\int \csc u \, du = -\ln|\csc u + \cot u| + C$$

$$\text{Area} = \int_a^b [f(x) - g(x)] \, dx$$

$$\text{Volume (Disk)} = \pi \int_a^b [f(x)]^2 \, dx$$

$$\text{Volume (Washer)} = \pi \int_a^b [f(x)]^2 - [g(x)]^2 \, dx$$

$$\text{Volume (Cylindrical Shells)} = \int_a^b 2\pi(\text{shell radius})(\text{shell height}) \, dx$$

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